CLIMATE CHANGE AND HEALTH IN KENYA

CONCEPTUAL FRAMEWORK AND DATA REVIEW

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Acronyms

ACPC	African Climate Policy Centre
AfDB	African Development Bank
AFIDEP	African Institute for Development Policy
LSHTM	London School of Hygiene & Tropical Medicine
MoH	Ministry of Health
NCCAP	National Climate Change Action Plans
NDC	Nationally Determined Contribution
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WHO	World Health Organisation
WHA	World Health Assembly

Glossary

Climate projection: Simulated response of the climate system to a scenario of future emissions or concentrations of greenhouse gases (GHGs) and aerosols and changes in land use, generally derived using climate models.

Climate scenario: A plausible and often simplified representation of the future climate, based on an internally consistent set of climatological relationships that has been constructed for explicit use in investigating the potential consequences of anthropogenic climate change, often serving as input to impact models. Climate projections often serve as the raw material for constructing climate scenarios, but climate scenarios usually require additional information such as the observed current climate.

Exposure: The presence of people; livelihoods; species or ecosystems; environmental functions, services, and resources; infrastructure; or economic, social, or cultural assets in places and settings that could be adversely affected.

Greenhouse gases (GHGs): Gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of radiation emitted by the Earth's surface, by the atmosphere itself, and by clouds. This property causes the greenhouse effect.

Hazard: The potential occurrence of a natural or human-induced physical event or trend that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources.

Impacts: The consequences of realised risks on natural and human systems, where risks result from the interactions of climate-related hazards (including extreme weather / climate events), exposure, and vulnerability. Impacts may be referred to as consequences or outcomes and can be adverse or beneficial.

Representative concentration pathways (RCPs): Scenarios that include time series of emissions and concentrations of the full suite of greenhouse gases (GHGs) and aerosols and chemically active gases, as well as land use/land cover. They usually refer to the portion of the concentration pathway extending up to 2100.

Resilience: The capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure while also maintaining the capacity for adaptation, learning and transformation.

Risk: The potential for adverse consequences where something of value is at stake and where the occurrence and degree of an outcome is uncertain. Risk results from the interaction of vulnerability (of the affected system), its exposure over time (to the hazard), as well as the (climate-related) hazard and the likelihood of its occurrence.

Urban heat island: The relative warmth of a city compared with surrounding rural areas, associated with heat trapping due to the close proximity of tall buildings, the heat-absorbing properties of urban building materials, reduced ventilation, and heat generated directly from human activities.

Vulnerability: The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

(IPCC 2021)

Background

Few public health crises match the complexity, global reach and impact on health threatened by climate change. From heat stress to malnutrition and respiratory illness, harmful effects of a changing climate manifest as various health outcomes; they can occur directly or incidentally, acutely or over time. For this reason, climate change is often described as a risk multiplier, compounding multiple stressors beyond the coping point, particularly of the most vulnerable.

Many of the causal pathways between climate-related hazards and health outcomes remain incompletely understood, owing in part to the difficulty in dissecting indirect effects from environmental and socioeconomic causes and more broadly, the longstanding underinvestment in environmental health research (Zinsstag et al. 2018; Murray et al. 2020). In 2008, the World Health Assembly resolved that Member States commit to prioritizing research on climate change and health, however over a decade later and despite a steady increase in publications on the topic, much of the research intensity stems from a small subset of countries (Berrang-Ford et al. 2021). That countries most vulnerable to the effects of climate change have been underrepresented in this output only further underscores the need for concerted efforts to support local research, policy, and action.

Focusing on Kenya, this project aims to strengthen understanding of the impact of a changing climate on health for the country's diverse and growing population. Improving the evidentiary basis for climate-sensitive health outcomes may support key stakeholders and decision-makers in their further development of climate change and health policies.

Kenya's Climate

The Republic of Kenya encompasses a surface area of 582 646 km^2 with a population of 52.6 million. It has an equatorial climate with several zones, broadly comprising a hot and humid coastal area in the southeast, a temperate inland region, central tropical highlands, and a large arid and semi-arid northern region (Figure 1; WHO 2015).

The most recent climate change assessments show that relative to a baseline period (1850 – 1900), the climate in Africa has experienced an increase in air temperature at a considerably faster rate than the global average (Ranasinghe et al. 2021). Sea levels have also risen around Africa over the past 30 years threatening coastal areas with flooding and erosion.

In Kenya, projected temperature rises of 1.7°C to 3.5°C from 2050 to 2100 are forecast for low and high representative concentration pathways (RCP; low emissions scenario 2.6, high 8.5). Extremes in precipitation are expected to bring greater risk of flooding events, while arid and semi-arid regions are likely to suffer longer and more frequent drought cycles. It's equatorial position and large agrarian sector make it highly vulnerable to the impacts of climate change (Mwangi & Mutua 2014; Althor et al. 2016; Signorelli et al. 2016) to the extent that Kenya was listed among the top ten most vulnerable countries in a climate risk ranking assessment, after experiencing extreme precipitation and flooding in 2018 (Climate Risk Index; Eckstein et al. 2020).

Health and Climate Change in Kenya – key policy action to date

Climate change policy in Kenya is provisioned through a five-year National Climate Change Action Plan (NCCAP; 2018 – 2022, which succeeded the 2013 – 2017 plan). In 2016, ratification of the Climate Change Act established in law the Kenyan government's responsibilities to incorporate climate change into national and devolved county activities.

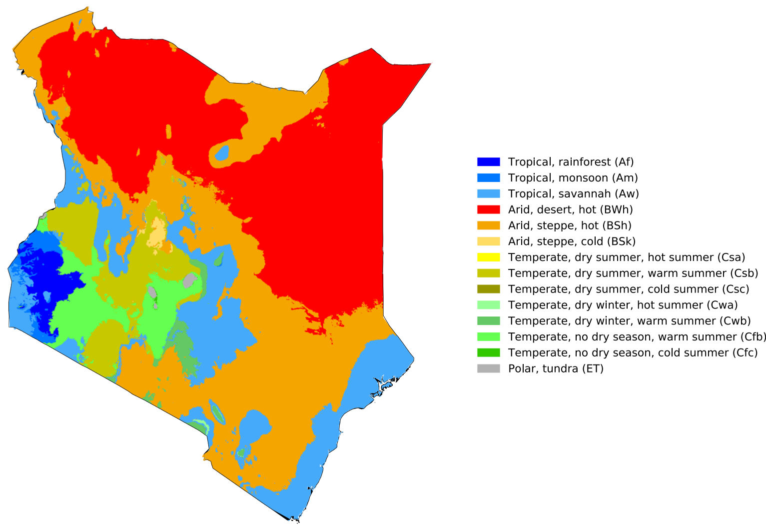


Figure 1. Map of climatic zones in Kenya.

The Act provides the legal basis for the NCCAP and mandates that mitigation efforts are aligned with the Nationally Determined Contributions (NDC) of the Paris Agreement of the United Nations Framework Convention on Climate Change (MEF 2018). These require a reduction by 32% of greenhouse gas emissions (GHG) by 2030 compared to the business-as-usual scenario. Since the Climate Change Act (2016) also stipulates that mitigation and adaptation efforts are operationalized at both national and subnational levels, two Ministries are recognized as key stakeholders to lead in developing climate change and health policy – these are the Ministry of Health and the Ministry of Environment and Forestry (MoH and MEF; AFIDEP & LSHTM 2021).

As the first decade of Kenya's climate change action plans approaches, a recent policy review identified that health outcomes of climate change policy have been largely overlooked (AFIDEP & LSHTM 2021). The current plans identify important but isolated consequences to health, such as vector-borne disease, but are generally missing a systems-wide approach to the range of impacts on vulnerable people from multiple intersecting climate stressors. A partnership between the London School of Hygiene and Tropical Medicine (LSHTM) and the African Institute of Development Policy (AFIDEP) aims to improve understanding of cross-sectoral policy solutions addressing health impacts of climate change and reciprocal climate co-benefits.

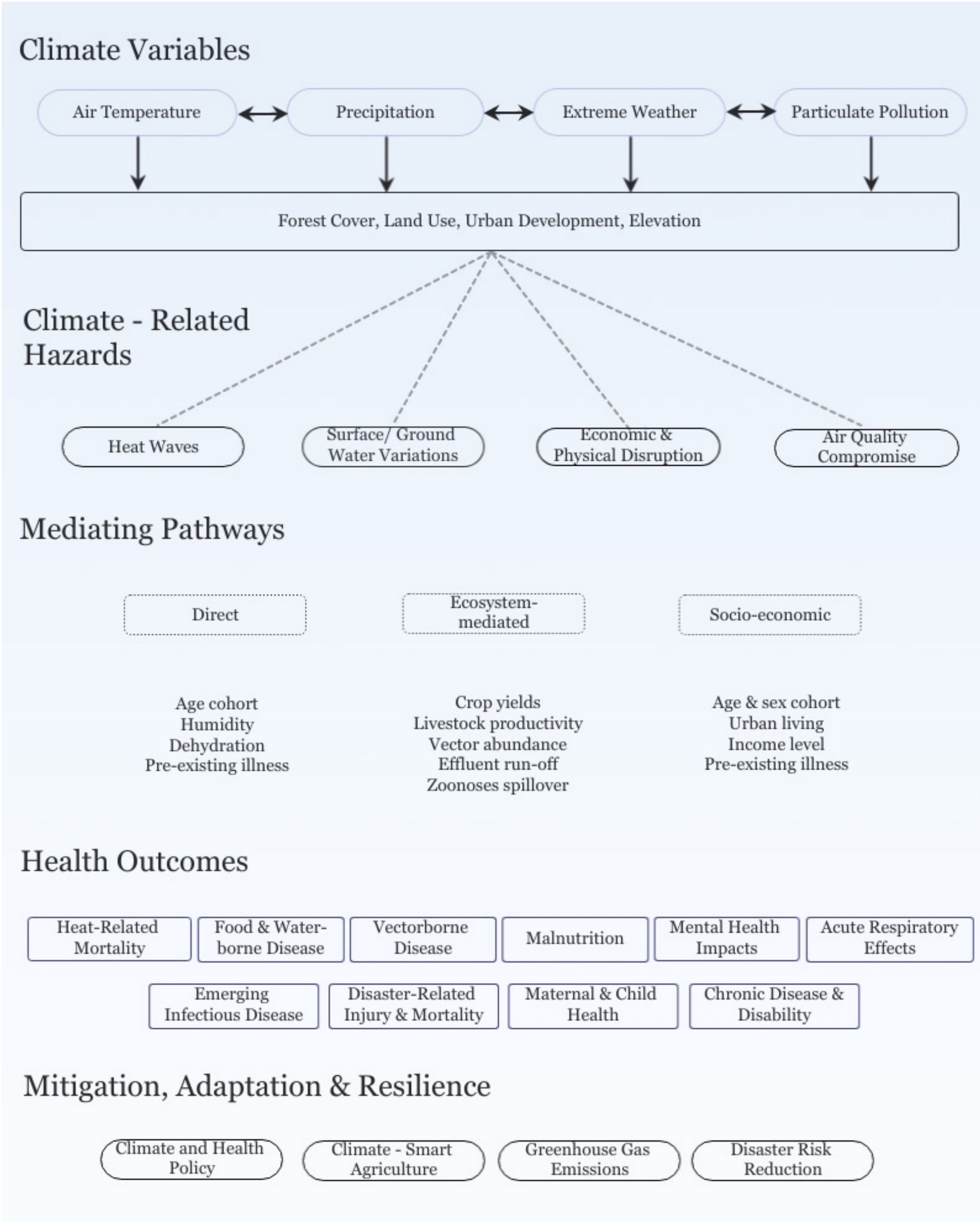
Report Objectives

The objectives of this report are two-fold:

1. to develop a framework to illustrate drivers of climate hazards and their impact on health outcomes; and
2. to collect and identify datasets that might be useful in the development of evidence supporting climate and health policy in Kenya.

To highlight how different types of data can be used in impact assessment and future projections of climate-sensitive health outcomes, three case studies are also described.

A Framework for Climate Change and Health



In this framework, the direction of effect traverses the page illustrating how climate variables (shown at the top of the figure) are successively influenced by various determinants, drivers, and mediating pathways – many of them overlapping – eventually resulting in health outcomes. Mitigation, adaption, and resilience measures anchor the framework at the bottom of the figure.

Climate Variables

Climate variables, including air temperature, precipitation, extreme weather systems, and particulate pollution, represent environmental exposures that can become hazardous to human health. These exposures do not act in isolation but are interconnected and combine to form and influence weather systems, for example particulate pollutants can also have varying effects on climate through absorptive or reflective capacities (Nolte et al. 2018).

These variables are influenced by physical topographical determinants such as urbanization, forest cover, other sources of land usage and elevation for example, urban heat island effects occur when impervious building and road materials contribute to higher urban temperatures in comparison to surrounding rural landscapes (Chiabai et al. 2018; Simwanda et al. 2019). These determinants affect the development of climate-related hazards.

Climate–Related Hazards

Heat waves, drought or flooding, storm-damaged infrastructure or geography, or compromised air quality are hazards associated with the physical environment that can present risks to human health. They can have long-lasting impacts, as occurs with persistent air pollution in urban centres, or have abrupt but devastating effects, such as mudslides in densely populated areas.

Mediating Pathways

Whether a hazard results in a health outcome is determined by mediating pathways encompassing vulnerability (for example, pre-existing illness) and length (transient or chronic) and odds of exposure (e.g., urban or rural living) (Ebi & Haines 2020; IPCC 2021). These pathways are direct or indirect, and the latter category is further sub-defined as ecosystem-mediated or socio-economic. Ecosystem-mediated pathways involve ecological drivers such as vector abundance and its consequent outcome of vector-borne disease, or water-borne disease outbreaks related to warming water temperatures. Socio-economic factors such as age cohorts and income level can influence susceptibility to illness or ability to receive prompt treatment (e.g. mental health). Although the pathways are presented separately in this figure, many variables, such as pre-existing illness, apply to multiple paths.

Health Outcomes

The impact of a changing climate on health has a variety of manifestations. Active lines of investigation in Kenya have provided baseline climate and health associations, for example on temperature-related morbidity and mortality associated with informal settlements in Nairobi (Egondi et al. 2012; Scott et al. 2017); seasonal patterns of enteric diseases in Kenyan children suggesting waterborne transmission routes (Shah et al 2016); the impact of warming temperatures on malaria vector species habitat and lifecycles in coastal regions of Kenya (Le et al. 2019); correlations between child stunting and climate and socio-economic variables in Kenya (Signorelli et al. 2016); and farmer's despair of extreme weather on their livelihoods (Mwaniki & Ngibuini 2020).

Mitigation, Adaption, and Resilience

Mitigation activities aim to reduce the impact of climate change by addressing contributing factors, however as Kenya is a minor contributor to greenhouse gas production but is highly vulnerable to changing climatic conditions, adaptation policy has been prioritized. Kenya has launched major initiatives in development of climate-smart agriculture under the frameworks of the Agriculture Sector Development and National Climate Change Response strategies (2010), as well as mainlining renewable energy policies (AFIDEP & LSHTM, 2021).

METHODS

Identifying data sources

There is a growing need to identify, organize and synthesize the large volumes of data being produced worldwide by various government ministries, private organizations, and research groups to bridge the divide between knowledge generation and action. To support the evidentiary basis for climate and health policy, longitudinal data sets on health, environment and socio-economic indicators can be combined with global open-source meteorological data to develop location-specific climate impact assessments and future forecasting.

For this report, data resource gathering occurred through an iterative process of discovery through general web searching; discussions with key experts; and searches of the literature, as well as key organization webpages involved in climate impact modelling on health. As the project evolves, further identified data sets may be added to create a 'live' bank of data resources specific to Kenya.

Listing of Data Sources

The listing is divided into data themes encompassing the main variables in each resource and links are provided to the database. Many web-based resources aggregate data from multiple sources, so some duplicated data is likely across data sets. Data sets identified as 'global' are often multi-source. The time span over which data has been collected and examples of the types of data variables are described.

Evaluating data for use

Prior to use, datasets must be audited to evaluate their quality, accuracy, and consistency; this will be conducted as an addendum to this report. Quality appraisal of data includes consideration of the period over which collection occurred, granularity of the data collected, and any evident gaps during the collection period. Accuracy and consistency of collected data may be assessed through triangulation with other sources (where available).

Listing of Data Sources

THEME	DATA SOURCE	COUNTRY	YEARS	VARIABLES	WEB LINK
Agricultural Data	FAOSTAT	Global	1961-2019	Production, prices, land use, trade, employment, forestry data	http://www.fao.org/faostat/en/#data/RL
	World Soil Information	Global	1989 - 2020	Soil characteristics and mapping	https://www.isric.org/
	HarvestChoice	Africa	2006 - 2016	Agriculture and Crop Production Data	HarvestChoice | IFPRI : International Food Policy Research Institute
	Global Animal Disease Information System	Global	-	Livestock disease database	Empres-i (fao.org)
Land Cover	European Space Agency GlobCover	Global	2004 – 2005; 2009	Land Use	http://due.esrin.esa.int/page_globcover.php
	USGS Earth Explorer (incorporates NASA MODIS satellite data)	Global	2002 - 2020	Surface Reflectance; Vegetation; Thermal anomalies & fires; Elevation; NVDI	https://earthexplorer.usgs.gov/
	Global Land Data Assimilation System	Global	1948 - 2021	Vegetation, soil, elevation, climate, atmosphere data	GLDAS: Project Goals | LDAS (nasa.gov)
	Global Biodiversity Information Facility	Global	-	Biodiversity data	GBIF
Child Growth & Malnutrition	WHO Global Database on Child Health and Malnutrition	Global	-	Weight-for-height; height-for-age; weight-for-age; BMI	https://www.who.int/teams/nutrition-and-food-safety/databases/nutgrowthdb

Climate Adaptation/ Mitigation Research & Policies	Climate Change and Adaptation, University of Nairobi	Kenya	-	-	https://icca.uonbi.ac.ke/research-projects
	Kenya Government, NACCP	Kenya	2018-2022	-	http://www.environment.go.ke/wp-content/uploads/2020/03/NCCAP_2018-2022_ExecutiveSummary-Compressed-1.pdf
	ClimateWatch	Kenya	-	Emissions & targets, NDCs, vulnerability scores	Climate Data for Action | Climate Watch | Emissions and Policies (climatewatchdata.org)
Flooding	Global Flood Database	Global	2000 - 2018	Date, duration and cause of event, exposed and displaced populations, mortality	Global Flood Database (cloudtostreet.info)
Food Systems Data	Food Systems Dashboard	Global	-	Cereal yield, vegetable yield, agricultural employment, crop losses, food insecurity indices	https://foodsystemsdashboard.org/countrydashboard
	Famine Early Warning Systems Network	Global	1985 - 2021	Food Insecurity Index	https://fews.net/east-africa/kenya
	Global Forest Cover	Global		Primary Forest Loss, Tree Cover Loss	https://globalforestwatch.org/map/
Global Burden of Disease	Institute for Health Metrics and Evaluation	Global	-	Morbidity and mortality, demographics, health indices	http://www.healthdata.org/kenya
	WHO Global Health Observatory	Global		Health indices	https://www.who.int/data/gho/data/countries/country-details/GHO/kenya?countryProfileId=26e47f18-038f-4560-8c78-0c70e7ebdfe8
	GIDEON database	Global	1348 - 2021	Disease outbreaks data	https://www.gideononline.com/

	Malaria Atlas Project	Global	2008 - 2013	Malaria Incidence (P. falcifarum & P. vivax) and Vector Distribution	https://malariaatlas.org/explorer/#/
	Walter Reed Biosystematics Unit VectorMap	Global	1961 - 2021	Distribution and geospatial arthropod data	http://vectormap.si.edu/
Meteorological Data	Kenya Meteorological Department	Kenya		Air pollution, weather data, satellite data	https://meteo.go.ke/resources/downloads
	Climate Data Library	Kenya	1981 - 2010	Climate forecasts, monitoring, models and analysis	https://iridl.ldeo.columbia.edu/index.html?Set-Language=en
	Climate Data Store	Global		Climate data and forecasts	https://cds.climate.copernicus.eu/#!/home
	Climatic Research Unit	Global	1850 - 2021	Temperature data	https://www.uea.ac.uk/groups-and-centres/climatic-research-unit
	Climate Data Online	Global		Climate data	https://www.ncdc.noaa.gov/cdo-web/
	WorldClim	Global		Historical climate data and projections	https://www.worldclim.org/data/index.html
	International Disaster Database	Global	1900 - present	Meteorological, hydrological, and climatological disaster records	EM-DAT | The international disasters database (emdat.be)
	European Centre for Medium-range Weather Forecasts	Global			https://www.ecmwf.int/en/forecasts/datasets
	Climate Hazards Infrared Precipitation with Stations (CHIRPS)	Africa	1981 - 2020	Daily, pentadal, monthly precipitation dataset	https://www.chc.ucsb.edu/data/chirps

	Tropical Rainfall Measuring Mission	Global	1997 - 2015	Tropical precipitation factors	The Tropical Rainfall Measuring Mission (TRMM) | NASA Global Precipitation Measurement Mission
Pollution Levels	UNEP, Urban Air Action Platform	Global	-	Air quality indices	https://www.unep.org/explore-topics/air/what-we-do/monitoring-air-quality/urban-air-action-platform?_ga=2.161981502.322049805.1631957236-301831320.1627389238
	IQAir Air Quality Index	Kenya	-	Air Quality Index, PM2.5 hourly and daily measures	https://www.iqair.com/kenya/nairobi
	EDGAR – Emissions Database for Global Atmospheric Research	Global	1970 - 2018	GHG emissions and air pollutants	https://edgar.jrc.ec.europa.eu/country_profile/KEN
Population Demographics	Kenya National Bureau of Statistics, 2019 Census	Kenya	2019	Age & gender distribution	https://www.knbs.or.ke/?p=5621
	UN Population Division, World Population Prospects	Global	2019	Population demographics	https://population.un.org/wpp/Download/Standard/Population/
	USAID Demographic Health Surveys Program	Global	2008 - 2020	Population and Health demographic data	www.dhsprogram.com
	Integrated Public Use Microdata Series (IPUMS) – Terra (integrates UEA climate data)	Global	1900 - 2014	Census and Survey Data	https://www.ipums.org/
	Oakridge National Laboratory LandScan Global	Global	2019	Population Density data	https://landscan.ornl.gov/
Socioeconomic Data	Kenya National Bureau of Statistics, 2019 Census	Kenya	2019	Transport, employment, and energy usage; educational	https://www.knbs.or.ke/

				enrollment; medical facilities	
Urban Development	UN Habitat, Urban Planning Report	Kenya	2018	Urban cover	https://unhabitat.org/urban-planning-for-city-leaders-a-handbook-for-kenya
	Global Roads Open Access Data Set	Africa	1980 - 2010	Road maps	https://sedac.ciesin.columbia.edu/data/set/groads-global-roads-open-access-v1
Other Tools	WorldBank - Climate Change Knowledge Portal	Kenya	2015	Country profiles	https://climateknowledgeportal.worldbank.org/country/kenya/vulnerability
	Climate & Health Publications Tool	Global	-	Publications	https://apsis.mcc-berlin.net/climate-health/
	Global Climate Risk Index	Global	-	Vulnerability Index	Germanwatch

Case Studies

To demonstrate the breadth of impact assessment and health outcomes projections based on changing climatic conditions, three examples are presented as case studies, using global, regional, and country-specific data sets. The first case study focuses on direct effect of climate change on vectors of human diseases whereas the latter two illustrate climate-sensitive outcomes indirectly influenced by certain ecological and socio-economic vulnerabilities.

1. Early warning systems for predictions of mosquito-borne disease

- Nosrat, C., Altamirano, J., Anyamba, A., Caldwell, J. M., Damoah, R., Mutuku, F., Ndenga, B., & Labeaud, A. D. (2021). Impact of recent climate extremes on mosquito-borne disease transmission in Kenya. *PLoS Neglected Tropical Diseases*, *15*(3), 1–17.
- Colón-González, F. J., Bastos, L. S., Hofmann, B., Hopkin, A., Harpham, Q., Crocker, T., Amato, R., Ferrario, I., Moschini, F., James, S., Malde, S., Ainscoe, E., Nam, V. S., Tan, D. Q., Khoa, N. D., Harrison, M., Tsarouchi, G., Lumbroso, D., Brady, O. J., & Lowe, R. (2021). Probabilistic seasonal dengue forecasting in Vietnam: A modelling study using superensembles. *PLoS Medicine*, *18*(3), 1–30.

Dengue fever is a mosquito-borne disease first reported as an outbreak in 1982 in coastal Kenya and has re-emerged in epidemic form periodically since then. A recent study combined monthly mean air temperatures and rainfall data with vector abundance data from a household trapping program alongside surveillance data from children presenting to local hospitals in two western and two coastal Kenyan sites to determine impact of climate conditions on vector abundance and risk of disease (Nosrat et al. 2021). The authors suggest that preventive interventions including early warning systems may reduce epidemic potential. To illustrate a dengue forecasting system, Colón-González et al. (2021) used historical health incidence data and longitudinal climate data to fit models to a 19-year period in Vietnam. These models were then combined into a superensemble which was shown to improve the accuracy of seasonal predictions for dengue outbreaks up to three months in advance, providing sufficient time for disease mitigation activities to be put in place. A limitation of this type of early-warning-system is a requirement for long-term, accessible, sub-national data to feed into the models, though these are rarely available. However, with Kenya's climatic conditions expected to become more favourable for Dengue outbreaks (Nosrat et al. 2021), the prospect of more informed decision-making through the use of accurate disease forecasting systems may spur investment into improved surveillance.

2. Rift Valley Fever in livestock and spillover in farming communities

- Pedro, S. A., Abelman, S., & Tonnang, H. E. Z. (2016). Predicting Rift Valley Fever Inter-epidemic Activities and Outbreak Patterns: Insights from a Stochastic Host-Vector Model. *PLoS Neglected Tropical Diseases*, *10*(12), 1–26.
- Iacono, G. Lo, Cunningham, A. A., Bett, B., Grace, D., Redding, D. W., & Wood, J. L. N. (2018). Environmental limits of Rift Valley fever revealed using ecoepidemiological mechanistic models. *Proceedings of the National Academy of Sciences of the United States of America*, *115*(31).

Rift Valley Fever is a viral disease of ruminants of the *Bunyavirales* order with most spillover to people occurring as an occupational or foodborne hazard. It is endemic in eastern and southern African countries primarily, including Kenya, Tanzania, and South Africa (Pedro et al 2016; Iacono et al 2018). Transmission between animals is vector-mediated but intermittent epidemics occur in livestock influenced by intense precipitation and possibly waning herd immunity. People are infected after handling or consuming animal tissues or through exposure to bodily fluids or aerosols during slaughter processes, and to a lesser extent, through mosquitos or biting flies. Both mild and severe human infections are reported, but fatality is low, on average less than 1%. A study by Iacono et al (2018) used daily temperature data from Kenyan weather stations combined with satellite data of natural and artificial water bodies to determine the total water surface area available for mosquito egg-laying (oviposition).

Fluctuations of water surface area and temperature were incorporated into separate compartmental models for livestock reservoirs and mosquito vectors to identify the range of climate variables that drive vector extinction and persistence and subsequent endemnicity in livestock, with implications for vulnerable communities.

3. Climate, crop yields and childhood mortality

- Belesova, K., Gasparrini, A., Sié, A., Sauerborn, R., & Wilkinson, P. (2017). Annual Crop-Yield Variation, Child Survival, and Nutrition among Subsistence Farmers in Burkina Faso. *American Journal of Epidemiology*, *187*(2), 242–250.

In food-insecure regions, extreme weather including drought may lead to large-scale losses in crop production and consequent undernutrition in subsistence farming communities. Children are particularly vulnerable to and visible indicators of famine-related morbidity and mortality. A study by Belasova et al. (2017) evaluated the health metric, middle- upper-arm-circumference (MUAC) in children under 5 years of age, and crop yield data, as predictors for child survival. Health indices, population demographic and socio-economic data, as well as agricultural yields for five key crops, were obtained for a region in western Burkina Faso. Crop yields and MUAC scores were explored against child survival through Cox proportional hazard models, controlling for confounders not limited to season of birth, parental reading abilities, village infrastructure (medical facilities), and undernutrition treatment program availability. Survival of children was negatively associated with low crop yields (represented by a calculated food crop productivity index) in the year of birth, and severe acute undernutrition represented by a MUAC score <115. Multilevel linear regression models found that MUAC correlated with lifetime average crop yields but not crop yields in the year of birth. The authors posit that poor harvests influence child nutritional status and survival and that projected changes in extreme weather resulting in prolonged and more frequent droughts should be accommodated in future adaptation planning.

Conclusions

Interest in climate change and health has grown worldwide, however the volume of research conducted in countries that are highly vulnerable to climate change is underrepresented. This report begins with a climate and health framework that provides an illustration of the various determinants, drivers, and mediating pathways that influence climate hazards and their consequent health impacts. Where locally relevant data is available to populate these causal pathways, they can be studied to better inform decision-making by stakeholders and to support climate and health policy. It is evident that a range of Kenyan data sources are available and key case studies demonstrate how different types and sources of data can be applied to benefit climate change adaptation planning in this context. Further work is required to assess the quality of the data available and to identify gaps in the climate and health evidence base, pertinent to Kenya.

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